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jc891 U.S. PTO 09/656406 09/06/00

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PTO/SB/05 (4/98)
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UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 C.F.R § 1.53(b))

Attorney Docket No.	AIR COMP
First Inventor or Application Identifier	Donald C. Erickson
Title	AIR COMPRESSION IMPROVEMENT
Express Mail Label No.	EE451582748US

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

ADDRESS TO: Assistant Commissioner for Patents, Box Patent Application, Washington, DC 20231

1. [X] * Fee Transmittal Form *(e.g., PTO/SB/17)* *(Submit an original and a duplicate for fee processing)*
2. [X] Specification [Total Pages 9] *(preferred arrangement set forth below)*
   - Descriptive title of the Invention
   - Cross References to Related Applications
   - Statement Regarding Fed sponsored R & D
   - Reference to Microfiche Appendix
   - Background of the Invention
   - Brief Summary of the Invention
   - Brief Description of the Drawings *(if filed)*
   - Detailed Description
   - Claim(s)
   - Abstract of the Disclosure
3. [X] Drawing(s) *(35 U.S.C. 113)* [Total Sheets 1]
4. Oath or Declaration [Total Pages 1]
   a. [X] Newly executed (original or copy)
   b. [ ] Copy from a prior application (37 C.F.R. § 1.63(d)) *(for continuation/divisional with Box 16 completed)*
      i. [ ] DELETION OF INVENTOR(S) Signed statement attached deleting inventor(s) named in the prior application, see 37 C.F.R. §§ 1.63(d)(2) and 1.33(b).

NOTE FOR ITEMS 1 & 13: IN ORDER TO BE ENTITLED TO PAY SMALL ENTITY FEES, A SMALL ENTITY STATEMENT IS REQUIRED (37 C.F.R. § 1.27), EXCEPT IF ONE FILED IN A PRIOR APPLICATION IS RELIED UPON (37 C.F.R. § 1.28).

5. [ ] Microfiche Computer Program *(Appendix)*
6. Nucleotide and/or Amino Acid Sequence Submission *(if applicable, all necessary)*
   a. [ ] Computer Readable Copy
   b. [ ] Paper Copy (identical to computer copy)
   c. [ ] Statement verifying identity of above copies

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ACCOMPANYING APPLICATION PARTS

7. [ ] Assignment Papers (cover sheet & document(s))
8. [ ] 37 C.F.R.§3.73(b) Statement *(when there is an assignee)* [ ] Power of Attorney
9. [ ] English Translation Document *(if applicable)*
10. [X] Information Disclosure Statement (IDS)/PTO-1449 [X] Copies of IDS Citations
11. [ ] Preliminary Amendment
12. [X] Return Receipt Postcard (MPEP 503) *(Should be specifically itemized)*
13. [X] * Small Entity Statement(s) *(PTO/SB/09-12)* [ ] Statement filed in prior application, Status still proper and desired
14. [ ] Certified Copy of Priority Document(s) *(if foreign priority is claimed)*
15. [ ] Other: .....

16. **If a CONTINUING APPLICATION,** *check appropriate box, and supply the requisite information below and in a preliminary amendment:*
    [ ] Continuation [ ] Divisional [ ] Continuation-in-part (CIP) of prior application No: _____/_____
    Prior application information: Examiner _____ *Group / Art Unit:* _____

For CONTINUATION or DIVISIONAL APPS only: The entire disclosure of the prior application, from which an oath or declaration is supplied under Box 4b, is considered a part of the disclosure of the accompanying continuation or divisional application and is hereby incorporated by reference. The incorporation can only be relied upon when a portion has been inadvertently omitted from the submitted application parts.

17. CORRESPONDENCE ADDRESS

[ ] *Customer Number or Bar Code Label* *(Insert Customer No. or Attach bar code label here)* or [X] *Correspondence address below*

Name	Donald C. Erickson				
	Energy Concepts Co.				
Address	627 Ridgely Ave.				
City	Annapolis	State	MD	Zip Code	21401
Country	USA	Telephone	410-266-6521	Fax	410-266-6539

Name (Print/Type)	Donald C. Erickson	Registration No. (Attorney/Agent)	
Signature	Donald C Erickson	Date	SEPT. 5, 2000

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FEE TRANSMITTAL for FY 1999

Patent fees are subject to annual revision.
Small Entity payments must be supported by a small entity statement, otherwise large entity fees must be paid. See Forms PTO/SB/09-12.
See 37 C.F.R. §§ 1.27 and 1.28.

TOTAL AMOUNT OF PAYMENT ($) 380

Complete if Known	
Application Number	
Filing Date	SEPT. 5, 2000
First Named Inventor	Donald C. Erickson
Examiner Name	
Group / Art Unit	
Attorney Docket No.	AIRCOMP

09/654406 09/05/00

METHOD OF PAYMENT (check one)

1. [X] The Commissioner is hereby authorized to charge indicated fees and credit any over payments to:

Deposit Account Number: 05-1067

Deposit Account Name: Donald C. Erickson

[ ] Charge Any Additional Fee Required Under 37 CFR §§ 1.16 and 1.17

2. [X] **Payment Enclosed:** [X] Check [ ] Money Order [ ] Other

FEE CALCULATION

1. BASIC FILING FEE

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
101	760	201	380	Utility filing fee	380
106	310	206	155	Design filing fee	
107	480	207	240	Plant filing fee	
108	760	208	380	Reissue filing fee	
114	150	214	75	Provisional filing fee	

SUBTOTAL (1) ($) 380

2. EXTRA CLAIM FEES

		Extra Claims		Fee from below	Fee Paid
Total Claims	20	-20** =	0	X	0
Independent Claims	3	- 3** =	0	X	0
Multiple Dependent					0

**or number previously paid, if greater; For Reissues, see below

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description
103	18	203	9	Claims in excess of 20
102	78	202	39	Independent claims in excess of 3
104	260	204	130	Multiple dependent claim, if not paid
109	78	209	39	** Reissue independent claims over original patent
110	18	210	9	** Reissue claims in excess of 20 and over original patent

SUBTOTAL (2) ($) 0

FEE CALCULATION (continued)

3. ADDITIONAL FEES

Large Entity Fee Code	Large Entity Fee ($)	Small Entity Fee Code	Small Entity Fee ($)	Fee Description	Fee Paid
105	130	205	65	Surcharge - late filing fee or oath	
127	50	227	25	Surcharge - late provisional filing fee or cover sheet.	
139	130	139	130	Non-English specification	
147	2,520	147	2,520	For filing a request for reexamination	
112	920*	112	920*	Requesting publication of SIR prior to Examiner action	
113	1,840*	113	1,840*	Requesting publication of SIR after Examiner action	
115	110	215	55	Extension for reply within first month	
116	380	216	190	Extension for reply within second month	
117	870	217	435	Extension for reply within third month	
118	1,360	218	680	Extension for reply within fourth month	
128	1,850	228	925	Extension for reply within fifth month	
119	300	219	150	Notice of Appeal	
120	300	220	150	Filing a brief in support of an appeal	
121	260	221	130	Request for oral hearing	
138	1,510	138	1,510	Petition to institute a public use proceeding	
140	110	240	55	Petition to revive - unavoidable	
141	1,210	241	605	Petition to revive - unintentional	
142	1,210	242	605	Utility issue fee (or reissue)	
143	430	243	215	Design issue fee	
144	580	244	290	Plant issue fee	
122	130	122	130	Petitions to the Commissioner	
123	50	123	50	Petitions related to provisional applications	
126	240	126	240	Submission of Information Disclosure Stmt	
581	40	581	40	Recording each patent assignment per property (times number of properties)	
146	760	246	380	Filing a submission after final rejection (37 CFR § 1.129(a))	
149	760	249	380	For each additional invention to be examined (37 CFR § 1.129(b))	

Other fee (specify) _____

Other fee (specify) _____

*Reduced by Basic Filing Fee Paid

SUBTOTAL (3) ($) 0

SUBMITTED BY

Complete *(if applicable)*

Name (Print/Type)	Donald C. Erickson	Registration No. (Attorney/Agent)		Telephone	410-266-6521
Signature	Donald C Erickson			Date	9/5/00

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STATEMENT CLAIMING SMALL ENTITY STATUS (37 CFR 1.9(f) & 1.27(b))--INDEPENDENT INVENTOR

Docket Number (Optional) AIRCOMP

Applicant, Patentee, or Identifier: DONALD C. ERICKSON

Application or Patent No.: _____

Filed or Issued: SEPTEMBER 5, 2000

Title: AIR COMPRESSION IMPROVEMENT

As a below named inventor, I hereby state that I qualify as an independent inventor as defined in 37 CFR 1.9(c) for purposes of paying reduced fees to the Patent and Trademark Office described in:

- [X] the specification filed herewith with title as listed above.
- [ ] the application identified above.
- [ ] the patent identified above.

I have not assigned, granted, conveyed, or licensed, and am under no obligation under contract or law to assign, grant, convey, or license, any rights in the invention to any person who would not qualify as an independent inventor under 37 CFR 1.9(c) if that person had made the invention, or to any concern which would not qualify as a small business concern under 37 CFR 1.9(d) or a nonprofit organization under 37 CFR 1.9(e).

Each person, concern, or organization to which I have assigned, granted, conveyed, or licensed or am under an obligation under contract or law to assign, grant, convey, or license any rights in the invention is listed below:

- [ ] No such person, concern, or organization exists.
- [ ] Each such person, concern, or organization is listed below.

Separate statements are required from each named person, concern, or organization having rights to the invention stating their status as small entities. (37 CFR 1.27)

I acknowledge the duty to file, in this application or patent, notification of any change in status resulting in loss of entitlement to small entity status prior to paying, or at the time of paying, the earliest of the issue fee or any maintenance fee due after the date on which status as a small entity is no longer appropriate. (37 CFR 1.28(b))

DONALD C. ERICKSON		
NAME OF INVENTOR	NAME OF INVENTOR	NAME OF INVENTOR
Donald C Erickson		
Signature of inventor	Signature of inventor	Signature of inventor
9/5/00		
Date	Date	Date

Certification under 37 CFR 1.10 (if applicable)

EE451582748US

"Express Mail" mailing number

9/5/00

Date of Deposit

I hereby certify that this application is being deposited with the United States Postal Service "Express Mail Post Office to Addressee" service under 37 CFR 1.10 on the date indicated above and is addressed to the Commissioner of Patents and Trademarks, Washington, D.C. 20231.

MARY WITTNER

(Typed or printed name of person mailing application)

Mary Wittner

(Signature of person mailing application)

AIR COMPRESSION IMPROVEMENT

CROSS-REFERENCE TO RELATED APPLICATIONS

Not applicable.

STATEMENT REGARDING THE FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable.

REFERENCE TO A MICROFICHE APPENDIX

Not applicable.

BACKGROUND OF THE INVENTION

All types of air compressors share an ambient temperature sensitivity - both the capacity and the efficiency decrease as the ambient temperature increases. The compressor-specific power demand is approximately proportional to the absolute temperature, which makes the efficiency proportional to the inverse absolute temperature. The compressor capacity is proportional to the density of the inlet air.

These sensitivities become particularly pronounced in combustion engines, in which the compressed air is used to combust a fuel and ultimately produce power. Both the power output and engine efficiency are de-rated at warm ambients. The degradation is not so severe with reciprocating engines, which require little more than stoichiometric air. The degradation is very severe with combustion turbines, which require on the order of 3 or 4 times stoichiometric air.

One known method of counteracting the warm ambient degradation of air compressors is by cooling the inlet air, either evaporatively or with a refrigerant. The refrigerated cooling can be done either in refrigerated air coils or by direct contact with sprayed chilled water. The refrigeration is supplied by either mechanical or absorption refrigeration systems, and in some instances through a cold storage medium (ice or chilled water).

Another approach to cooling inlet air is by over-spraying, typically via fogging. Sufficient water is injected into the air in fine droplet form such that it not only reduces the temperature adiabatically to the dew point, but additional droplets remain un-evaporated,

and carry into the compressor suction. Those droplets rapidly evaporate as compression proceeds, slowing the temperature increase caused by compression, and hence effectively adding to the amount of inlet cooling. For the droplets to remain suspended in the air into the suction rather than separate out excessively, they should be in the fog-size range, i. e., less than 40 microns in diameter and preferably 5 to 20 microns. Another advantage of this size range is that the droplets are small enough that they do not erode the compressor blades.

The problems with the current approaches to cooling compressor inlet air include the following. Most compressors would benefit thermodynamically from sub-freezing inlet temperatures, or at least could be designed to benefit from those temperatures. However, there are many practical difficulties. Especially with high rotational speed combustion turbines, there is a possibility of ice buildup on inlet guide vanes, which then could spall off and damage the compressor blades. This imposes a practical limiting temperature of about 4°C for many inlet cooling systems. Cooling below that temperature will require some additional technique of reducing the humidity level of the cold air below saturation - reheat, etc. On the refrigeration side, special measures are also required to deal with the H_2O removal from the air in sub-freezing conditions: periodic defrosting of the air coils, or continuous addition of a melting agent. Furthermore, the refrigeration system requires proportionately more input power to reach the lower temperatures - more shaft power for mechanical refrigeration, or higher quality heat for absorption refrigeration. With mechanical refrigeration, the power necessary to reach sub-freezing temperatures is so large, and the marginal improvement in compression is so small, that there is little or no net gain from cooling to sub-freezing temperatures.

Even when the inlet cooling is restricted to above-freezing temperatures, another major problem remains. The compressor benefit is substantially due to the sensible cooling of the inlet air, with almost no added benefit from the latent cooling, i.e., the amount of moisture condensed out of the air. However, the latent cooling typically represents 25 to 50% of the total refrigeration load. For example, consider 35°C air at 50% relative humidity, which is cooled to 5°C at 100% relative humidity. The moisture content decreased from 1.8 weight percent to 0.55 weight percent. For these conditions, only 51% of the total refrigeration provides sensible cooling, and 49% causes the water condensation. Thus, much of the refrigeration is effectively wasted.

The overspray or fogging approach to inlet cooling also presents problems. The two foremost are that the cooling is adiabatic, as opposed to the diabatic cooling of the refrigeration approach; and that a source of pure water is required for every bit of cooling accomplished. The adiabatic limitation causes the inlet sensible temperature to be no lower than the dew point. The cost and availability of pure water mitigate against this approach at many sites.

What is needed, and included among the objects of this invention, are apparatus and process which overcome the prior art problems cited above, i. e., an inlet cooling system wherein the latent load contributes to effective cooling in addition to the sensible load contribution; where the benefits of the overspray approach are available without the limitations of needing a large source of pure water and that the inlet temperature is limited to the dew point; where the thermodynamic benefits of sub-freezing inlet temperatures are achievable without the practical problems; and wherein the refrigeration system is activated by low temperature waste heat so as not to detract from the compressor shaft power reduction provided by the inlet cooling system.

DISCLOSURE OF THE INVENTION

The above advantages are obtained in a process for compressing air comprising: chilling air to between the dew point and the frost point; collecting the resulting condensate; injecting the condensate into the chilled air in the form of very small droplets; and compressing the chilled droplet laden air. They are also obtained in an apparatus for increasing the capacity and efficiency of an air compressor comprising: a means for air chilling which is supplied with a refrigerant; a condensate collection system for condensate condensed from said air by said means for chilling; a means for converting said condensate into fog-sized droplets; a means for injecting said droplets into said air downstream of said chilling means; and a duct for supplying said chilled and fogged air to the suction of said air compressor.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

Figure 1 illustrates the three essential features of the invention: an air chilling system including means for condensate collection; an overspray system; and an air compressor.

Figure 2 shows a more complex application of the invention wherein the compressor is part of a combustion engine, and the engine waste heat powers an absorption refrigeration unit (ARU) which in turn supplies chilling to the air chiller.

DETAILED DESCRIPTION OF THE INVENTION

Referring to Figure 1, inlet air for air compressor 10 is first supplied to air chiller 11, where it is cooled to below the dew point by cooling coil 12. The condensate is collected in collection pan 13, then pressurized to between 6 and 20 MPa in pump 14, and routed to fogging nozzles 15 of overspray system 16. From there, the chilled, saturated, oversprayed air is routed to the suction of compressor 10. There may also be a spray water reservoir, filter, makeup source, and deionizing bed, to help ensure continuity and purity of the spray.

Referring to Figure 2, combustion turbine 20 is comprised of compressor 21, turbine 22, combustor 23, and regenerator 24. Inlet air for compressor 21 is filtered in filter 25, chilled to below the dew point in refrigerated air coil 26, and then fogged by spray nozzles 27. Liquid refrigerant is supplied to air coil 26 from ARU 28 via pressure letdown valve 29, and refrigerant vapor is returned to the ARU. Moisture condensed from the air is collected in collector 30, filtered and purified in filter-purifier 31, and pressurized in pump 32, then routed to the fogging nozzles 27. The heat of compression in compressor 21 evaporates all the fog droplets, and compressed air exits the compressor with the benefits of both sensible and latent cooling, and at a correspondingly lower temperature. The maximum thermodynamic benefit is obtained when the cooler compressed air is supplied to regenerator 24, as shown, although substantial benefit is also obtained without a regenerator. Fuel 33 is combusted with the compressed air in combustor 23, and the hot pressurized combustion gas is expanded in turbine 22 to produce shaft power. The hot exhaust may be routed through regenerator 24, diverter valve 34, heat recovery steam generator 35, and finally ARU 28, before exhausting to atmosphere through stack 36.

With the Figure 2 flowsheet, and assuming the operating conditions cited above (35°C, 50% relative humidity ambient, chilled to 5°C) the following benefits are achieved. The inlet air is sensibly cooled by 30°C, plus additional overspray cooling internal to the compressor of virtually the same amount (60°C cooling altogether). The turbine shaft power output increases by at least about 30%, and the efficiency increases by 5 to 20%, dependent upon the pressure ratio and whether or not regeneration is present. The maximum efficiency increase is obtained with regeneration, and with the lower pressure

ratio machines such as microturbines. Even with large combined cycle plants, an appreciable overall plant efficiency gain is realized, in addition to the major gain in capacity. The large amount of effective inlet cooling is achieved without the problems of sub-freezing conditions, and without need for a separate source of pure water for the fogging system. Since waste heat powers the absorption system there is almost no parasitic power offset to the increased capability.

The NH_3 - H_2O type of ARU adapts well to being directly heated by low temperature exhaust, e.g., 175°C or lower, and also to direct expansion chilling coils. However, LiBr ARUs may also be used, and need not be directly integrated, i.e., can use steam or hot water heating and chill water cooling circuit. The air cooling to below the dew point can be via direct contact, e.g., with a spray of recirculating chilled water, rather than via coils. With coils, more than one evaporation temperature can profitably be used.

The NH_3 - H_2O ARU can also be used to make ice, e.g., for thermal storage cooling of a peaking or variably loaded plant. With a combustion engine, the 60°C cooling cited above can be driven by as little as 100°C cooling of the exhaust, e.g., from 175°C to 75°C. For some applications it will be desirable to further refrigerate the inlet air to below freezing before fogging, and/or to do interstage fogging in lieu of inlet fogging. Compressed air supply systems will also benefit from this disclosure, plus also other types of combustion engines, such as reciprocating types.

Standard means of generating fog-sized droplets are contemplated, including the techniques described in the enclosed references. The refrigeration for chilling can be from mechanical compression systems in lieu of by absorption.

CLAIMS

1. A process for compressing air comprising:

- chilling air to between the dew point and the frost point;
- collecting the resulting condensate;
- injecting the condensate into the chilled air in the form of very small droplets; and
- compressing the chilled droplet laden air.

2. The process according to claim 1 wherein said droplets are predominantly in the size range of 5 to 40 microns - normally referred to as fog.

3. The process according to claim 2 wherein said chilling is to a temperature below about 5°C.

4. The process according to claim 2 additionally comprising combusting a fuel with said compressed air; and work expanding the resulting hot compressed combustion products.

5. The process according to claim 2 additionally comprising supplying said chilling by an absorption refrigeration unit (ARU).

6. The process according to claim 5 additionally comprising combusting a fuel with said air and work expanding the resulting hot combustion products; and supplying heat to said ARU from said work expander exhaust.

7. The process according to claim 6 wherein said ARU is an ammonia-absorption type, and additionally comprising supplying ARU ammonia refrigerant directly to an air coil for said chilling step; and providing exhaust heating directly to the ARU absorbent.

8. The process according to claim 2 additionally comprising partially compressing said chilled air prior to injecting said fog droplets.

9. The process according to claim 2 additionally comprising refrigerating said chilled air to below the frost point before injecting fog.

10. An apparatus for increasing the capacity and efficiency of an air compressor comprising:

- a means for air chilling which is supplied with a refrigerant;
- a condensate collection system for condensate condensed from said air by said means for chilling;
- a means for converting said condensate into fog-sized droplets;
- a means for injecting said droplets into said air downstream of said chilling means; and
- a duct for supplying said chilled and fogged air to the suction of said air compressor.

11. The apparatus according to claim 10 wherein said means for air chilling is comprised of refrigerated air coils.

12. The apparatus according to claim 11 additionally comprised of an ARU which supplies refrigerant directly to said air coils.

13. The apparatus according to claim 12 wherein said ARU is comprised of NH_3 - H_2O working fluid, and a heat exchanger between said working fluid and a combustion exhaust gas.

14. The apparatus according to claim 13 wherein said combustion exhaust gas is from a combustion engine which is supplied by said air compressor.

15. The apparatus according to claim 14 wherein said combustion engine is a reciprocating engine.

16. The apparatus according to claim 14 wherein said combustion engine is a combustion turbine.

17. The apparatus according to claim 16 wherein said combustion turbine includes a regenerator.

18. The apparatus according to claim 10 additionally comprised of a LiBr ARU which supplies said chilling.

19. An apparatus for increasing the efficiency of a combustion turbine comprising:

a) a chiller for the inlet air for the combustion turbine which chills said air to below the dew point;

b) a collector for condensate from said chiller; and

c) a system for injecting said condensate into said chilled air in the form of fog-sized droplets.

20. The apparatus according to claim 19 additionally comprised of an ARU which supplies cooling to said chiller and which is supplied waste heat from said combustion turbine exhaust; and at least one of:

a) a heat recovery steam generator; and

b) a regenerator.

ABSTRACT OF THE DISCLOSURE

The efficiency and capacity of an air compressor (10) (Figure 1) are increased by pre-cooling the inlet air to below the dew point in air chiller (11), and then injecting the resulting condensate into the chilled air in the form of fog-sized droplets in a fogger (16). The advantages extend to combustion engines, and especially to regenerative combustion turbines.

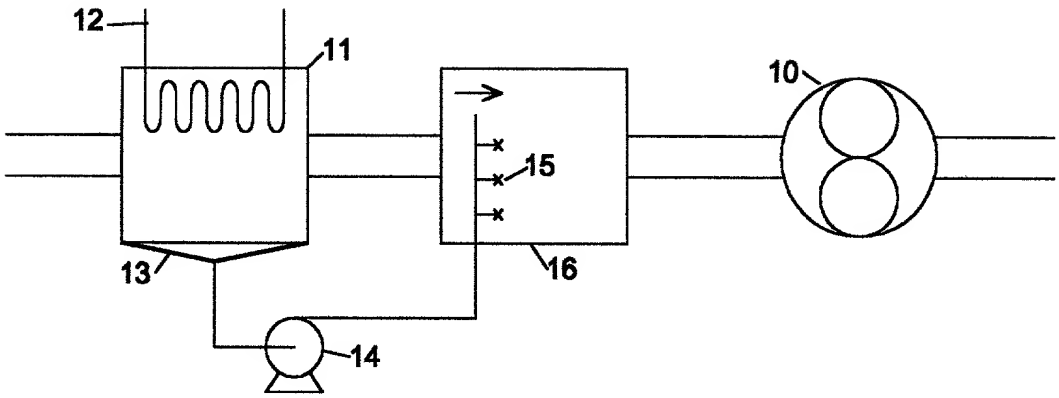

Figure 1

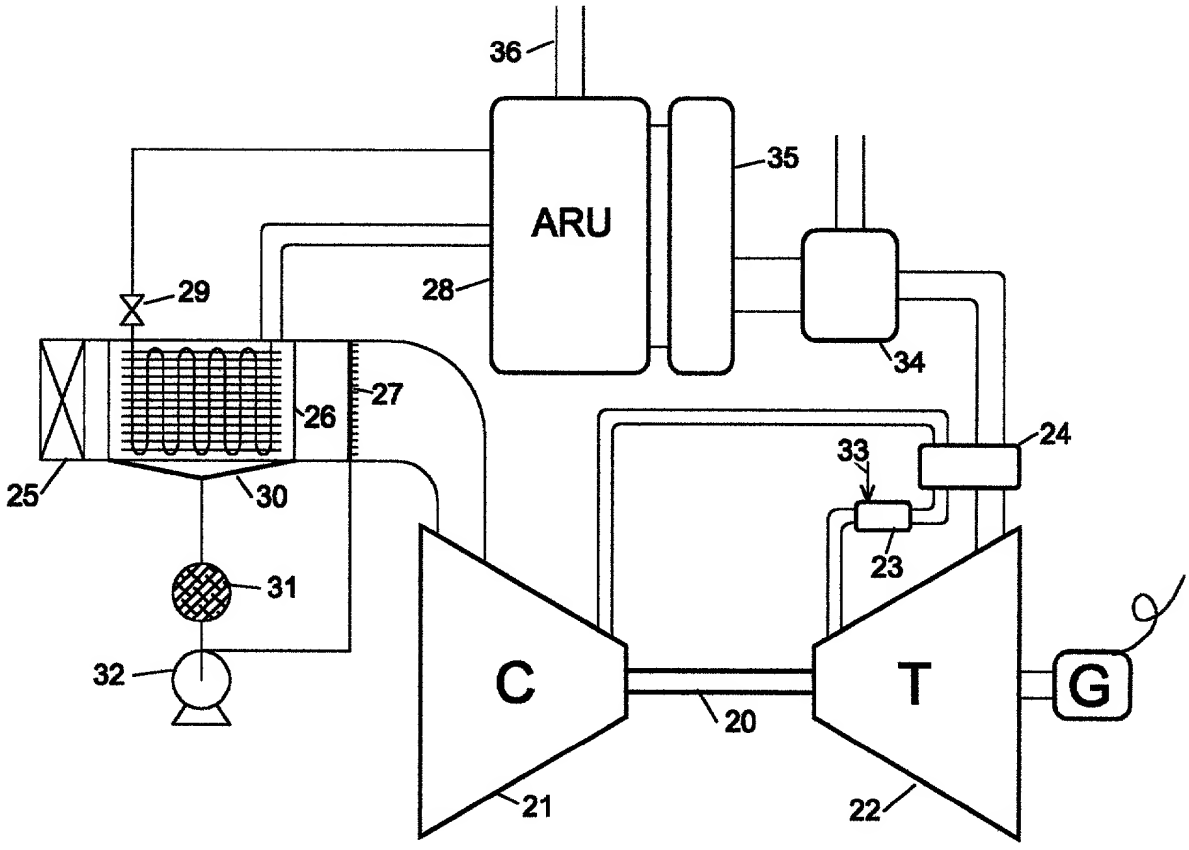

Figure 2

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DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (37 CFR 1.63)

☒ Declaration Submitted with Initial Filing OR ☐ Declaration Submitted after Initial Filing (surcharge (37 CFR 1.16 (e)) required)

Attorney Docket Number	AIRCOMP
First Named Inventor	Donald C. Erickson
COMPLETE IF KNOWN	
Application Number	/
Filing Date	SEPT. 5, 2000
Group Art Unit	
Examiner Name	

As a below named inventor, I hereby declare that:

My residence, post office address, and citizenship are as stated below next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

AIR COMPRESSION IMPROVEMENT

(Title of the Invention)

the specification of which
☒ is attached hereto
OR
☐ was filed on (MM/DD/YYYY) [ ] as United States Application Number or PCT International Application Number [ ] and was amended on (MM/DD/YYYY) [ ] (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment specifically referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56.

I hereby claim foreign priority benefits under 35 U.S.C. 119(a)-(d) or 365(b) of any foreign application(s) for patent or inventor's certificate, or 365(a) of any PCT international application which designated at least one country other than the United States of America, listed below and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.

Prior Foreign Application Number(s)	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached? YES	NO
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐
			☐	☐	☐

☐ Additional foreign application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto:

I hereby claim the benefit under 35 U.S.C. 119(e) of any United States provisional application(s) listed below.

Application Number(s)	Filing Date (MM/DD/YYYY)	
		☐ Additional provisional application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

Burden Hour Statement: This form is estimated to take 0.4 hours to complete. Time will vary depending upon the needs of the individual case. Any comments on the amount of time you are required to complete this form should be sent to the Chief Information Officer, Patent and Trademark Office, Washington, DC 20231. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Assistant Commissioner for Patents, Washington, DC 20231.

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DECLARATION — Utility or Design Patent Application

I hereby claim the benefit under 35 U.S.C. 120 of any United States application(s), or 365(c) of any PCT international application designating the United States of America, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. 112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 CFR 1.56 which became available between the filing date of the prior application and the national or PCT international filing date of this application.

U.S. Parent Application or PCT Parent Number	Parent Filing Date (MM/DD/YYYY)	Parent Patent Number (if applicable)

☐ Additional U.S. or PCT international application numbers are listed on a supplemental priority data sheet PTO/SB/02B attached hereto.

As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith: ☐ Customer Number [ ] → *Place Customer Number Bar Code Label here*
OR
☐ Registered practitioner(s) name/registration number listed below

Name	Registration Number	Name	Registration Number

☐ Additional registered practitioner(s) named on supplemental Registered Practitioner Information sheet PTO/SB/02C attached hereto.

Direct all correspondence to: ☐ Customer Number or Bar Code Label [ ] *OR* ☒ Correspondence address below

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under 18 U.S.C. 1001 and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Name of Sole or First Inventor: ☐ A petition has been filed for this unsigned inventor

Given Name (first and middle [if any])	Family Name or Surname
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☐ Additional inventors are being named on the ____supplemental Additional Inventor(s) sheet(s) PTO/SB/02A attached hereto